

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Naofumi NAKAMURA et al.
Serial No.: 10/752,642
For: SEMICONDUCTOR DEVICE AND METHOD OF FABRICATING THE SAME
Filed: January 7, 2004
Examiner: Chris C. Chu
Art Unit: 2815
Conf. No.: 4109

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PRE-APPEAL BRIEF REQUEST FOR REVIEW

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

REASON FOR REQUEST

Claims 1-3, 11 and 12 are pending in the application and are rejected in the Final Office Action mailed on June 6, 2008. Claim 4 is pending and was objected to. Claims 5-10, 13-14 are pending and withdrawn. Appellants respectfully request that the Pre-Appeal Brief Panel consider the following arguments.

REMARKS/ARGUMENTS

Reconsideration and withdrawal of the rejections of the application are respectfully requested in view of the remarks herewith, which place the application into condition for allowance. Claims 1-3, 11 and 12 are pending in this application and are rejected in the Final Office Action mailed June 6, 2008. Claims 1-3, 11 and 12 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 6,468,906 to Chan et al. ("Chan") in view of U.S. Patent No. 6,861,758 to Jan ("Jan").

Claim 1 recites, *inter alia*:

"A semiconductor device having a multilayer structure...

... at least two wiring layers, formed in a wiring groove ... and a via contact embedded in a via hole ...

wherein the metal wiring material of the via contact contains an additive which is not contained in the metal wiring materials of the at least two wiring layers.” (emphasis added)

Applicants agree with the Final Office Action of June 6, 2008 that, “Chan et al. does not disclose an additive within the metal wiring of the via contact.” Therefore, Applicants will not further discuss Chan. Rather, Applicants assert that Jan does not teach or suggest the features of claim 1, or supply the deficiencies of Chan.

Specifically claim 1 provides a multilayer structure wherein “the metal wiring material of the via contact contains an additive which is not contained in the metal wiring materials of the at least two wiring layers.” Therefore, claim 1 relates to a device wherein the wiring layers *do not* contain additives that are contained in the via contact. Jan, by contrast, discloses an additive that is *expressly* and *deliberately* included in the electrically conductive layer 132 and the electrically conductive material 142, as shown in FIG. 9. Jan does not disclose or suggest the deficiency of Chan and the feature of the present invention, namely “wherein the metal wiring of the via contact contains an additive which is not contained in the metal wiring materials of the at least two wiring layers.” And, in fact, by providing for the electrically conductive layer 132 and the electrically conductive material 142 to *expressly* and *deliberately* include an additive, Jan teaches away from the instant invention.

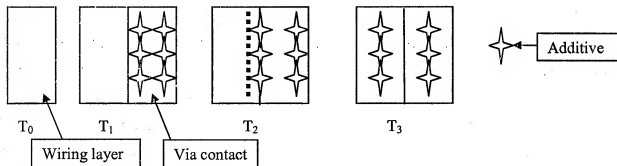
Specifically, in Figs. 6-9 and col. 4, lines 22-58 of Jan discloses: A dielectric layer 134 having an opening 136 is provided on an electrically conductive layer 132 as shown in FIG. 6. Dopant 138 is implanted to the electrically conductive layer 132 “before” embedding a conductive material in the opening 136 as shown in FIG. 7. Then, the electrically conductive material 142 is embedded in the opening 136 as shown in FIG. 8. After that, a first doped region 140 and a second doped region 144 are formed by annealing. Accordingly, Jan expressly discloses that an additive implanted into the electrically conductive layer 132, which is a lower wiring, is diffused in the via provided on the electrically conductive layer 132, and then in the electrically conductive material 142, which is an upper wiring, provided on the via. In particular, column 4, lines 41-47, of Jan states:

FIG. 9 shows first doped region 140 in electrically conductive layer 132 and second doped region 144 in electrically conductive material 142. First doped region 140 and second doped region 144 are formed by annealing electrically conductive layer 132 after dopant 138 has been implanted into electrically conductive layer

132. Dopant 138 is able to diffuse to form first doped region 140 and second doped region 144.

The Advisory Action at page 2 asserts that the “metal wiring layers of the claimed structure of claims 1 and 11 inherently include the additive within the metal wiring layers by diffusion from the via contact near the contact areas as shown in Fig. 9 of Jan reference.” In summary, the Advisory Action stated that since claims 1 and 11 do not claim any barrier layer between the via contact and the metal wiring layers as a constituent element, an additive must be diffused in the metal wiring layers. However, Applicants do not accept the assertion of the Advisor Action; the claims should be examined within the scope of the matters restricted in the claims. While Applicants do **NOT** agree with the inherency position of the Advisory Action, e.g., because it has **NOT** been shown that diffusion necessarily occurs (for instance, since diffusion is also a dependent upon the nature of the materials of the wiring and the via contact layer), the Advisory Action’s inherency position necessarily **FAILS** because the USPTO **MUST** concur that diffusion is not an instantaneous process. Therefore, there is no inevitable reason for claiming the barrier layer as a constituent element of claims 1 and 11.

More specifically, assuming *arguendo* (and without any admission) that diffusion occurs, the additive would **NOT** instantly diffuse into the wiring layer, i.e., the USPTO **MUST** concur that diffusion is a process that occurs over time. Therefore, consider the following illustrations and explanatory text, wherein from left to right, the wiring layer is first laid down, then the via contact, and time is flowing forward from the image on the left to the images on the right (and thus, T_0 is time zero and T_1 is when the layers are initially laid next to each other, and T_2 is a period thereafter, again assuming *arguendo* diffusion occurring without any admission, and T_3 is a time period later than T_2 wherein diffusion is again assumed for purposes of the argument, without any admission, and it is assumed that equilibrium has occurred).



With regard to the above illustrations, and assuming without admission diffusion occurring: At Time T_1 , the product is neither taught nor suggested by Chan and Jan: There is clearly a layer ***WITHOUT*** any additive as called for by the instant claims. Similarly, at T_2 there is clearly a portion of a layer that is ***WITHOUT*** additive which constitutes a layer ***WITHOUT*** any additive not taught or suggested by Chan and Jan, as called for by the instant claims.¹ The product at T_3 is different from Chan and Jan because the relative concentration of additive across both layers is less than would be found if additive was initially supplied to both layers. Nevertheless, even if the product at T_3 is asserted by the USPTO to be obvious from Chan and Jan, that is irrelevant, as clearly the product at Times T_1 and T_2 is not taught or suggested by Chan and Jan as there is clearly a layer without additive as called for by the instant claims.

Furthermore, as stated above, Applicants do ***NOT*** agree that diffusion necessarily occurs. There is no teaching or suggestion in the art – either Chan or Jan – that there is indeed diffusion of additive across layers. Nor is there anything in the record that can dispute that at a time there ***MUST*** be a layer with additive and a layer without additive, i.e., that the claimed structure ***MUST*** exist for a definite period, before any of the hypothetical diffusion of the Advisory Action occurs. Indeed, the Advisory Action cites ***NOTHING*** to support its diffusion theory, i.e., there is nothing in the record showing that the alleged diffusion ***MUST*** occur, or at any rate that it occurs if it indeed occurs. In short, the USPTO cannot argue that at all points in time there are both a wiring layer and a via contact layer that contain additive due to diffusion; but rather, ***MUST*** agree that there is at least very finite time periods when there is a wiring layer without additive and a via contact layer with additive, and hence, that which is claimed is ***NOT*** taught or suggested by Chan and Jan.

Again, contrary to the instant recitations of the claims, Jan discloses in Figs. 6-9 that the wiring level is first doped with an additive as shown in Fig 7 to form the first doped region, element 140. Then the via element 142 is formed in the structure (Fig. 8). *See also* col. 4, lines 22-47. Jan never discloses or suggests a structure at any time **“wherein the metal wiring of the via contact contains an additive which is not contained in the metal wiring materials of the at least two wiring layers.”** And such a structure indeed exists and is not taught or suggested – even under the “diffusion hypothesis” of the Advisory Action, as shown above.

¹ In the assumption of diffusion occurring, it also ***MUST*** be assumed that diffusion is occurring linearly from the region of highest concentration of additive to the region of lowest concentration of additive.

Therefore, claim 1 is patentable for at least the reasons herein given and of record.

Claim 11 also was rejected as being unpatentable over Chan in view of Jan. Claim 11 recites "a via contact ... which contains an additive which is not contained in the first wiring material of the first wiring layer ..." For at least the reasons stated above, Jan does not teach this feature or an additive not contained in a lower wiring but contained in a via contact.

Claims 2, 3 and 12 are dependent claims. Since the independent claims they depend upon are not obvious from Chan and Jan, as set forth above, claims 2, 3, and 12 are not obvious, and hence, patentable. Moreover, the particular recitations of claims 2 and 3 as each depends on claim 1, and claim 12 as it depends on claim 11 are not obvious because Chan and Jan do not teach or suggest the combinations of these claims, i.e., claims 2 and 3 do not stand or fall with claim 1 and claim 12 does not stand or fall with claim 11. And claim 4, which was only objected to as being dependent on rejected claim 1, is also patentable.

Based on the foregoing and the arguments of record, independent claims 1 and 11, and the claims dependent thereon, patentably distinguish over Chan in view of Jan and are therefore allowable.

CONCLUSION

In view of the foregoing remarks, all of the claims in this application are in condition for allowance. Reconsideration and withdrawal of the rejections and prompt allowance are earnestly solicited. In the event the Examiner disagrees with any of the statements appearing above with respect to the disclosures in the cited references, it is respectfully requested that the Examiner specifically indicate the portions of the reference, or references, providing the basis for a contrary view. Please charge any additional fees incurred by reason of this response and not paid herewith to Deposit Account No. 50-0320.

Respectfully submitted,
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